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The macroeconomic determinants of M&A activity in the United Kingdom

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Abstract

This research intends to study the multivariate relationship between the macroeconomic environment and M&A activity in the United Kingdom, to which it uses data comprising completed deals with an UK-based acquirer from January 1985 until December 2015. Employing time series econometrics, it concludes that: i) the macroeconomic determinants used as proxy for business cycles share a long-term pattern with deal activity; ii) short-term adjustment processes towards the long-run equilibrium arise following shocks in the variables used; iii) GDP seems to be the major driver of M&A in the short and long terms; and iv) in the long-run, the stock-market proves a less relevant factor impacting deal activity in the UK than in the United States. This study contributes to the existent literature by: i) extending the research to other geographies rather than the US; and ii) employing multivariate models to assess the bi-directional relationship between M&A activity and economic conditions.

Keywords: Mergers and Acquisitions; Macroeconomic activity; United Kingdom;

Introduction

The aim of the present dissertation is to contribute to the empirical research on the topics of mergers and acquisitions (M&A) waves and their relationship with economic cycles. Merger activity is documented in the literature to occur in bunches (Clark et al., 1988; Golbe & White, 1993), i.e., deal volume and frequency tend to concentrate in periods over time thus following an aggregated pattern. The work developed in this study looks to establish whether economic cycles are drivers of deal activity - and vice-versa – in the United Kingdom (UK). Previous research (Beckenstein, 1979; Choi & Jeon, 2011) found the link between the two to be statistically significant for the US, but deeper analysis is needed to better understand which macroeconomic fundamentals drive aggregated M&A decisions and whether or not these effects last over time and across countries.

Contribution of the Present Dissertation

The "M&A waves" debate has historically been geographically concentrated on the US. The UK falls behind its American counterpart in M&A research and, particularly, in studying the factors affecting M&A activity. Even if it is clearly a smaller market for M&A deals than the US, the UK ranks third in the value of deals in 2015 globally (China is number two) and first in Europe.

Researchers tend to focus on the US market as the quantity of information available is considerably higher and the country can be considered as the most reliable proxy for global

tendencies. However, it can be misleading to assume that M&A activity follows the same pattern across geographies, and that macroeconomic events and variables affecting its behavior are the same in each and every country.

This is not to say that the subject was left unexplored within the academic community. Although recent, authors such as Resende (2008) approached it successfully, laying the foundations for future research, much of it is, however, theoretical work which has not been statically supported. Moreover, the vast majority of contemporaneous research on macroeconomic effects on M&A waves has been grounded on ARIMA models, which, although useful, lack the ability to explore the bidirectional relationship between the two, i.e., the impact of a macroeconomic indicator, say GDP, on M&A activity and vice-versa. Only more recent studies, such as Choi & Jeon (2011), Gehringer (2015), Lonzano & Petz (2016), addressed these questions for the US, by employing VAR models to test for the impacts in the short-term and, in Choi & Jeon (2011)'s case, VEC models to complement the analysis with long-run effects.

Therefore, this research intends to be pioneer by employing models (VAR and VEC) that have proven to be useful providing a broader explanation for M&A behavior in a market that, although large and relevant, is somehow still left behind in this specific field of study. By combining these two features, this study is expected to be complete and unique and provide groundings for future research on the topic, not only for the UK but for other relevant European markets, whose tendencies, due to physical or ideological proximity, should be easier to replicate using as a benchmark the UK rather than the US.

Hypothesis Development

At first sight, one would instinctively assume that macroeconomic conditions and M&A activity go hand-in-hand. Furthermore, as M&A is, in the end, an investment activity, it is assumed that a booming economy will in the short-run lead to an increase in merger activity. A bull market or low interest rates, for instance, mean companies have access to more and cheaper financing, nurturing corporate investment. Following this, the first hypothesis arises:

Hypothesis 1: An upward economic cycle increases M&A activity in the short-run.

Beckenstein (1979), Dong et al. (2006) and others found macroeconomic fundamentals like GDP, the stock market and interest rates coherent with a growing economy to drive M&A activity up in terms of total amount spent by companies.

Research has shown, however, that M&A is a very specific type of investment activity, and a better economic environment may not necessarily mean an immediate increase in deal volume or frequency. In fact, the frequency of M&A deals may yield an inverse causality: weaker economic conditions may force companies to sell their assets (partially or totally) thus increasing the number of deals. Is this enough to offset the increase in purchasing power attached with a thriving economy? To evaluate this hypothesis, both the number of transactions and total acquisitions cost will be studied.

The above mentioned hypothesis makes sense from a short-term perspective. Surely, short-run investment decisions may be influenced by the current environment and thus companies will engage in investment activities that provide higher returns due to lower financing costs. But do economic cycles and M&A activity share a pattern over the long-run? Does a growing economy impact the volume and number of deals for years to come? This leads to the formulation of Hypothesis 2, which goes as follows:

Hypothesis 2: Economic cycles have long-run effects in M&A activity.

This claim is less supported by the literature than the previous ones, mainly because not many studies have developed further work regarding the matter. Choi & Jeon (2011) paved the way for future research by finding preliminary evidence on the US economic cycle as a long-term driver of M&A activity.

Finally, as an investment activity, it is expected for M&A to generate both short and long-term return. Therefore, it may very well be the case that deal activity could in turn significantly impact the economic environment and thus stimulate economic growth. Do M&A have a positive effect on the economy as a whole or do merger waves develop into bubbles driven by factors other than pure corporate strategy that will inevitably impair a country's economy? This leads to the third and last hypothesis of this study:

Hypothesis 3: M&A activity stimulates economic growth.

The rest of this dissertation proceeds as follows. The second section documents the previous literature that relates to the raised questions and their main inputs. The following section presents the two economic theories considered to support this research. Section four lists the chosen data and sample and the variables used. Then, in the fifth section the methodology describes the procedures used to carry on this study. Section six analyses and further discusses the regression results. The seventh section concludes and evaluates the results with the

hypotheses here described and finally, the last section presents the limitations and the grounds for future research.

Literature Review

The topic has been widely discussed within the academic community. An abundant number of studies has provided a significant understanding on the micro and macroeconomic factors driving M&A activity. Although this study focuses on macro-level indicators, it is believed that a thorough understanding of the micro-drivers of M&A activity could prove instrumental for the overall relevance of the research, as evidence of this relationship has been previously found.

Historically, research is focused on three main drivers: firm-level, industry-level and financial markets/macroeconomic-level. This research focus on the latter. A significant number of researchers have found evidence that M&A activity tends to occur in bunches across industries, probably meaning that there must be some macroeconomic fundamentals driving corporations' investment decisions (Harford, 2005). Literature has extensively tried to identify these drivers. Interest rates have been the basis for most of these studies, although closely followed by Industrial Production and either GNP or GDP (there is no evident distinction between both GNP and GDP effects. The first studies on the topic were carried out using GNP as variable; most recent ones have used GDP as proxy).

Steiner (1975) was pioneer linking merger activity with interest rates and GNP. Becketti (1986) tested for several macroeconomic variables, such as M1, Domestic Debt, GNP and the 3-month T-Bill, finding that these were able to explain around a third of the M&A activity during the analyzed period. Of these, interest rates were highly significant; GNP was also relatively significant. Guerard (1989) confirmed the relevance of interest rates, namely as they impact corporate financing, and almost all research found GNP/GDP to be significant (Golbe and White, 1988; Resende, 2008). On the other hand, the link between industrial production and M&A waves is yet to be confirmed. Although some researchers were successful in establishing this relationship, like Cook (2007), others have failed to do so (Guerard, 1989; Becketti, 1986; and Corro, 2012).

Similarly, evidence has been found for the correlation between stock market performance and M&A waves. Gort (1969) and Guerard (1989) found a positive correlation between the two; Shleifer and Vishny (2003) and Ang and Cheng (2006) also find the same results, either by testing directly for the relationship between the two variables or by addressing the tendency of overvalued companies to engage more frequently in M&A activities. Moreover, Verter (2002)

assesses, successfully, the impact of market volatility on M&A activity. However, some authors found this relationship not to be significant. Harford (2005) tested for the behavioral theory and could not find a significant correlation between stock prices and merger levels; Gugler, Mueller and Yurtoglu (2006) tested for the overvaluation and managerial discretion hypotheses, which are consistent with the behavioral theory, and although some support is found for each of the two, these do not appear as significant. The direction of causality has yet to be confirmed. On the one hand, as Becketti (1986) stresses, there is a logical connection one can extrapolate from: it is known that most of these acquisitions are made because the acquirer feels that the target may be underperforming. Therefore, they will look for the moment when the target's stock is trading under its "potential" value. This way, if mergers are completed quickly, this aggregate behavior should then mean that low stock prices help cause and predict higher M&A activity. On the other hand, however, most M&A deals take a long time to be completed (due to regulation, due diligence, etc) so that in the meanwhile investors can look for profits by investing in the target's stock, driving prices up. On this, timing is key: the date the researcher decides to be relevant (either the announcement or the conclusion date) might mean significantly different results. Furthermore, logical reason tells us that overvalued companies (and thus, on an aggregate level, a high-performing stock market) will benefit from more resources to invest, and they will very likely do so at least partially through M&A. It is not surprising, thus, that not only Becketti (1986) but also Melicher et al., (1983) found a pro-cyclical relationship between the quantity of transactions and stock market performance. It is also important to note that one cannot isolate stock market performance from other macroeconomic factors, as share prices are influenced by other economic fundamentals. This is indicative that a robust study should bear a multivariate model.

Over the last decades other variables than the ones mentioned above were tested. Money supply (M1) and inflation (CPI) were among them. However, so far few or none authors have found them to be statistically significant (Becketti, 1986; Resende, 2008). Differently, unemployment rate was found to be relevant explaining, at least partially, these waves Benzing (1993).

Also significant for the topic might be the research carried out by Becketti (1986) that instead of finding the indicators behind merger activity, tested for the co-movements between business cycles and M&A activity. The author defined these cycles using stock markets performance and economic activity as proxies, eventually finding out that the two tend to go hand-in-hand.

Economic Theory

Although mergers have long been treated as microeconomic events, obviously because they are ultimately subjected to management's investment decisions, there has emerged a set of authors who argue that these decisions are influenced by macroeconomic factors, that by doing so, generate periods of concentrated mergers and/or acquisitions followed by periods where M&A activity is reduced. Therefore, they argue, M&A activity follows a wave-type behavior.

As a macroeconomic event, researchers have used economic indicators to explain these movements, just like indicators are used to explain stock returns, housing bubbles or credit ratings. One of the first studies on the matter was carried out by Nelson (1959), that successfully established a correlation between stock market's performance and M&A waves. Since then, many authors approached the topic, of which many were successful not only confirming the waves but also finding the determinants of those waves. To back these results, two main theories have emerged.

The Expectations Theory

First introduced by Reid (1968), claims that M&A activity is correlated with future expectations of market activity and economic growth. This theory uses interest rates and stock prices as predictors for expectations of economic growth and cost of capital, i.e., stating that when stock prices are high and interest rates are low then future overall M&A activity is expected to increase. Why stock prices and interest rates? Fama (1981) argued that an aggregate increase in stock prices means the expectation of higher activity, leading to an increase in demand not matched by the supply side. Therefore, companies will be willing to invest to take advantage of this supply shortage, acquiring additional capacity. One of the ways firms can do this is through M&A. Low interest rates lead to a decrease in financing costs firms will incur to carry on these investments. Similarly, low interest rates will increase M&A rates of return, as cash flows are discounted at a lower rate. This aspect might be particularly relevant on getting shareholders' approval and influencing the markets perceptions on the firm's investment decisions. Therefore, the cost of capital will very likely impact the number of M&A transactions. This effect has been highly documented in the literature (Benzing, 1991; Shleifer & Vishny, 2003; Kamaly, 2007). Interestingly, the direction of the impact has been subject of discussion. Benzing (1991) and Choi and Jeon (2011) stated that cost of capital and M&A transactions were negatively correlated (indeed, matching the expected relation between stock market performance and M&A activity). However, both Steiner (1975) and Beckenstein (1979)

argued that there was in fact a positive correlation between interest rates (and thus cost of capital) and M&A transactions.

The Economic Disturbance Theory

Also known as the Economic Disturbance Theory, a concept introduced by Gort (1969). According to this hypothesis, macroeconomic events will cause a variation in future cash flow estimations for the business. Therefore, valuations will also change and discrepancies will arise between those of the shareholders and investors. Particularly, if after the shock investors value the business at a higher price than shareholders, M&A booms are likely to happen. Obviously, booms occur because the shock is a macroeconomic event impacting an entire economy thus causing aggregate shifts in economic agents' expectations. Other firm or industry-level events will cause these discrepancies at a smaller scale. Some authors have successfully linked M&A waves and shifts in economic conditions, using both GNP and GDP as proxies for the latter (Gort, 1969; Akbulut, 2005; Resende, 2008).

Recently, a slight variation of this theory has emerged in the literature. Instead of linking M&A activity and differences in valuation over the same company, its proponents argue that market inefficiencies (caused by the so-called "shocks" mentioned before) create under and overvalued companies. The former will bid for the latter, hoping to profit from the difference between the target's true value and the asked price or by paying equity (in theory, overvalued). Dong et al., (2006) establishes this relationship, concluding that these are highly dependent on managerial incentives.

Data

M&A Data

Data on M&A was collected from the Bloomberg and Reuters Terminals Databases satisfying the following criteria:

a) The completed deals announced from January 1985 to December 2015 in the UK;
b) The value of the deal is equal or greater than 1 million euros (excluding fees and expenses);
c) The acquirer is a UK private or public company or subsidiary;
d) The acquirer holds, after the deal, a majority stake on the target company.

The data set comprises 67.784 deals covering a 30-year period. Firm-level data was aggregated into quarterly observations, after which 124 observations are defined. Only completed deals

were included, although the relevant date is the one when the deal was announced. The announcement date is a more accurate way of estimating merger trends than the completion date, as these deals very often tend to take several weeks, sometimes months, to be concluded (due to regulatory obligations, shareholder negotiations, etc) and reflect the current economic environment at the time the decision process took place.

Aggregated merger activity is measured using two indicators: M&A frequency and transaction value. This has been a subject of discussion within the academic community over time. Pioneer studies focused on either Transaction Value or Number of Transactions. More recently, using both has become the norm within the relevant literature. Becketti (1986), Larach (2013), Haque et al. (1995) have all estimated the impact of macroeconomic determinants in both the total value generated in M&A transactions and in the number of completed deals. Others, like Choi and Jeon (2011) have gone further, adding merger transaction value/S&P 500 trading volume and transaction value/total asset as indicators. According to the authors, they expect these two additional variables to provide a "normalization effect".

After careful consideration, I decide to use both the number of transactions and the value of the transactions as proxies. This serves the purpose of trying to include as much information as possible when trying to explain this phenomenon. Although both are valid measures, using each one isolated would necessarily leave out important features that may prove relevant to this study. In principle, transaction value provides a more accurate estimation of the impact of a certain merger than the frequency of deals, as the economic value of a deal worth 1 million euros is undoubtedly smaller than that of a 10-million-euro deal. Moreover, the meaning of an increase in the volume of M&A deals is straightforward: in principle, more money invested is the result of an improving financial framework; an increase in the number of transactions, however, might actually be a consequence of a rise in the number of financially distressed companies. There is, nevertheless, an important drawback in measuring M&A activity through the volume generated: the universe of transactions which value is disclosed is smaller, since normally the acquirer does not have the obligation to reveal the acquisition price, so that the reported total value of transactions is probably understated. Using the number of transactions as indicator can thus prove instrumental in the estimation, as even if value and fees are hidden, the transaction must be made public by the parties involved.

Macroeconomic Data

Data on economic indicators comprises real GDP, the FTSE100 Index and the 3-month LIBOR Rate. All data is aggregated in quarters and was obtained through the FRED St. Louis database. These will constitute the variables of the estimation, alongside the M&A measures. Tables I and II present further detail on the variables and how they interact with each other.

Variables' Description

NumTrans: Includes the number of deals that took place between 1985 and 2015 in the UK, aggregated in quarters, presented in units. L_NumTrans is the natural logarithm of the series. According to the revised literature, integration of at least order 1 is expected.

VolumTrans: Includes the purchase price in each completed deal considered, aggregated into quarterly values, in British Pounds. L_VolumTrans is its natural logarithm. Again, a unit root is expected.

GDP: Includes quarterly observations of the real U.K. economic output, seasonally adjusted, from the first quarter of 1985 to the fourth quarter of 2015, presented in thousands of British pounds. L_GDP is the natural logarithm of this variable. Due to a trend behavior detected on preliminary analysis, aligned with a general agreement on economic literature of its non-stationary nature, it is likely that the first differences method will need to be applied to "stabilize" the series for a proper VAR model.

FTSE100 Index: Includes quarterly observations of the *close price* for the Index covering the 100 largest traded companies in the United Kingdom, presented in British Pounds. L_FTSE is the natural logarithm. FTSE, as for other indexes, is also documented to be non-stationary in the literature, so that its first differences are likely to be applied for the construction of a VAR, generating the returns on the Index.

LIBOR 3M: Includes quarterly observations of the 3-month LIBOR price, measured as a percentage. It serves the purpose of proxy for interest rates, which are believed, if low, to stimulate growth by providing cheaper financing. L_LIBOR3M is its natural logarithm. If applied, the first differences will transform the series to the variation, in percentage points, across quarters.

Methodology

Several different statistical methods have been used to establish a relationship between macroeconomic determinants and merger trends. These range from simple OLS models to

Vector Autoregressive (VAR), ARIMA and Markov's Switching Models. Until the 1980's, most authors developed studies where coefficients for macroeconomic factors were estimated mainly with multiple regression analysis (Steiner, 1975; Weston, 1961). From that point on, time series data was introduced to the study of M&A waves.

Since pioneer studies on the subject revealed some endogeneity problems, namely related to autocorrelation among the error terms, authors such as Resende (2008) and Benzing (1993) added autoregressive terms to their regressions. The results revealed that this term had a considerably high coefficient.

Since then, autoregressive (AR) and autoregressive moving average (ARMA) models became standard within the literature. Clark, Chkrabarti, & Chiang (1988); Guerard, 1989; Haque, et al., (1995), conducted some of the most relevant studies grounded on ARMA models applied to M&A waves. Others, such as Melicher et al. (1983), Shughart and Tollison (1984), employed autoregressive integrated moving average (ARIMA) models, which, according to Brooks (2014), "is one whose characteristic equation has a root on the unit circle.". Melicher et al. (1983)'s work is particularly interesting as it highlighted a multivariate relationship, by successfully examining that not only stock prices and interest rates affected M&A trends, but also M&A waves affected bankruptcy rates and production. Since then, other researchers have explored this two-sided relationship, mainly through vector autoregressive (VAR) and vector error correction (VECM) models. The most relevant include Choi & Jeon (2011) and Finn & Hodgson (2005) that assess the effect of different macroeconomic determinants on M&A activity and particularly its response to the shocks. Often, these tests are not carried out on their own: a Granger causality test is employed to examine whether or not individual factors could help predict merger trends. These latter studies have the merit of comprising a broader analysis, as they test for the short and long run relationships by employing both VAR and VEC models. Additionally, Town (1992) and Resende (2008) used Hamilton's Markov switching model and the two-state Markov switching model to test for the dynamic behavior of M&A trends.

This research paper aims at testing the relationship between M&A transactions, measured through deal volume and quantity, with several macroeconomic indicators, namely GDP, stock-market performance and short-term interest rates (through the 3-month LIBOR).

Due to the high probability of a certain degree of interdependence between variables, it is concluded that a multivariate model, more precisely a vector error correction (VEC) would prove the best option to fit the model to be estimated, after performing cointegration tests

(Johansen cointegration), alongside a Granger Causality test. The VEC model could prove instrumental for the purpose of this study. By not predetermining the direction of the causality, it allows to test both the impact of macroeconomic factors in M&A and, at the same time, the impact of M&A in those macro determinants. Additionally, the Granger causality test is a powerful tool as it allows researchers to assess the bi-directional causality between variables. In this test, the individual significance of the lagged value of the independent variable adds explanatory power to that variable, but the collective significance of interdependent variables adds explanatory power to the dependent variable. This way, one could, for example, using this method, test for the impact of GDP on the number of transactions and also the inverse effect. One variable is said to Granger Cause another variable if it rejects the null hypothesis of no causality. Moreover, a vector autoregressive (VAR) model will be constructed to complement the short-term analysis, namely through the observation of the impulse responses to shocks in selected variables.

The VEC Model

A Vector Error Correction Model (VECM), is a useful tool for estimating both short-term and long-term effects of one series on another. If two series are cointegrated, that means they are bounded together by a long-term relationship preventing them from wandering apart without bound. These processes were developed by Engel and Granger (1987), and in practice mean that a set of variables with a unit root, or I(1), is cointegrated if they share a linear cointegration that is stationary, or I(0). If two or more variables, say GDP and number of M&A, have an upward trend, then they are non-stationary. But because they are driven by the same trend, then the difference between series should show no trend anymore.

The first step towards the construction of the VEC would imply assessing the stationarity of the dependent variable (either Number or Value) and the three independent variables (GDP, FTSE and LIBOR3M). In order to do this, the ADF test is carried out on each variable. A balanced formulation can only be found if all of these variables are non-stationary. The existence of a unit root is a necessary condition for cointegration analysis. Therefore, subsequent analysis using a VEC model will imply all variables to be non-stationary, so that log-level data shall be employed.

Furthermore, before constructing the VEC model one must first check whether or not cointegration exists. The Johansen Cointegration Test (Johansen, 1991) is widely accepted as the most efficient procedure for cointegration testing between a set of variables. Other methods,

such as the Engle-Granger approach (Engel & Granger, 1987) are also used. This method, although very simple, has the drawback of estimating a maximum of one cointegration between variables. Since the model employed in this paper comprises several variables, this could impose limitation on the results, so the Johansen method will in turn be used.

The Johansen procedure uses two likelihood-ratio tests to assess cointegration between variables. These are the Trace Test and the Maximum Eigenvalue Test. For both, the null hypothesis states no cointegration. In which they differ is the alternative hypothesis (Lutkepohl, 2007). If cointegration is proved in the Johansen approach, then an assertion is made that the variables share a long-run equilibrium relationship. Afterwards, again, in case cointegration is confirmed, a Vector Error Correction Model is estimated. A VEC follows a similar structure as a VAR. The regression equation is the following:

$$(1)\ \Delta(y_t) = \alpha_1 + p_1 e_1 + p_2 e_2 + \ldots + p_i e_{t-i} + \sum \beta_i \Delta Y_{t-i} + \sum \Omega_i \Delta X_{t-i} + \sum \theta_i \Delta Z_{t-i} + \sum \lambda_i W_{t-i}$$

According to preliminary tests, a VEC system with NumTrans, GDP and FTSE100 as endogenous variables and LIBOR3M as exogenous is built. LIBOR3M is included as external because even if preliminary results show it as not entirely significant, it is believed it might have a strong link defining the other variables in the model. Therefore, the regression for Model 1 takes the following form:

$$(2)\ \Delta(\text{NumTrans})_t = \alpha_1 + p_1 e_1 + + p_2 e_2 + \ldots + p_i e_{t-i} + \beta_1 * \Delta (\text{NumTrans})_{t-1} + \ldots + \beta_n * \Delta (\text{NumTrans})_{t-n} + \Omega_1 * \Delta (\text{GDP})_{t-1} + \ldots + \Omega_n \Delta * dl(\text{GDP})_{t-n} + \theta_1 * \Delta (\text{FTSE})_{t-1} + \ldots + \theta_n * \Delta (\text{FTSE})_{t-n} + \lambda_1 * \text{LIBOR3M} + \varepsilon_t$$

Where e_n measure how deviations from the long-run relationship impact the changes in the variable in the next period. A negative and significant coefficient indicates that any short-term fluctuations around the independent and dependent variables will translate into a long-run relationship between them (Asari et al., 2011). The coefficients for the lagged series measure the short-term cross-relationships between the variables in the model.

It is important to mention that, although in theory "NumTrans" is referred as the dependent variable and GDP, FTSE and LIBOR3M as independent ones, in practice, in a VEC, there is no such thing as dependent or independent variables, as it comprises a series of regressions in which each variable acts as explanatory and explained variable. Therefore, in addition to the main equation mentioned above, each lagged variable will have its own regression, namely, adding to the one described above, a similar regression for GDP and FTSE100. The only

exception is the LIBOR3M variable, since it is included as an external variable and thus only its impact on the other variables is taken in account.

Accordingly, Model 2, using volume of transactions as measure of merger activity will entail the following equation:

(1) $\Delta(\text{VolumTrans})_t = \alpha_1 + p_1 e_1 + + p_2 e_2 + \ldots + p_i e_{t-i} + \beta_1 * \Delta\ (\text{VolumTrans})_{t-1} + \ldots + \beta_n * \Delta\ (\text{VolumTrans})_{t-n} + \Omega_1 * \Delta\ (\text{GDP})_{t-1} + \ldots + \Omega_n \Delta * dl(\text{GDP})_{t-n} + \theta_1 * \Delta\ (\text{FTSE})_{t-1} + \ldots + \theta_n * \Delta\ (\text{FTSE})_{t-n} + \lambda_1 * \text{LIBOR3M} + \varepsilon_t$

and two identical ones for GDP and FTSE100.

The optimal lag length to be applied in the VEC model will be defined with the help of different information criterion, namely the Hannan-Quinn (HQ), the Akaike (AIC) and the Schwarz (BIC).

The VAR Model

After estimating the VEC model, if it turns out that cointegrations holds, thus meaning a long-run equilibrium between variables, it is likely that the variables in the model adjust in the short-run to shocks caused by the other variables in the model. The impulse -response functions measure the percentage changes in the dependent variable following a previous change in one independent variable, being used as a measure of the temporal effects of shocks to the dependent variable (Gonzalo, 2012). To compute these responses, one must also build a Vector Autoregressive (VAR) model.

A VAR model establishes cross-relationships between a set of variables. It has been widely used in economic studies, although not particularly in M&A waves. Contrary to the VEC, in a VAR a proper model will imply all the variables to be stationary. If, however, non-stationary data were used, spurious regressions could be constructed. These regressions are misleading in the sense that they may appear to perfectly model two events and demonstrate elevated R^2 when in fact they are completely unrelated. Another pitfall that may arise has to do with the fact that t-statistics and F-statistics will no longer follow a student´s or F distributions. This could then lead to erroneous conclusions being made. Based on the results of the ADF test, a VAR model will be constructed with the level of the variable(s) without unit roots and the first difference of the variable for those with a unit root. Accordingly, VAR model 1 assumes the following formulation:

(2) $dl(NumTrans)_t = \beta_0 + \beta_1 * dl\ (NumTrans)_{t-1} + \ldots + \beta_n * dl\ (NumTrans)_{t-n} + \alpha_1 * dl(GDP)_{t-1} + \ldots + \alpha_n * dl(GDP)_{t-n} + \Omega_1 * dl\ (FTSE)_{t-1} + \ldots + \Omega_n * dlog(FTSE)_{t-n} + \theta_1 * l(LIBOR3M)_t + \varepsilon_t$

where the first difference of the dependent variable "NumTrans" relates to the levels or first differences of the independent variables GDP, FTSE and LIBOR3M, as a function of their own lags. Therefore, in addition to the main equation mentioned above, the VAR will also comprise two other regressions:

(3) $dl(GDP)_t = \beta_0 + \beta_1 * dl\ (GDP)_{t-1} + \ldots + \beta_n * dl\ (GDP)_{t-n} + \alpha_1 * dl(NumTrans)_{t-1} + \ldots + \alpha_n * dl(NumTrans)_{t-n} + \Omega_1 * dl\ (FTSE)_{t-1} + \ldots + \Omega_n * dlog(FTSE)_{t-n} + \theta_1 * log(LIBOR3M)_t + \varepsilon_t$

(4) $dl(FTSE)_t = \beta_0 + \Omega_1 * dl\ (NumTrans)_{t-1} + \ldots + \Omega_n * dlog(NumTrans)_{t-n} + \beta_1 * dl\ (FTSE)_{t-1} + \ldots + \beta_n * dl\ (FTSE)_{t-n} + \alpha_1 * dl(GDP)_{t-1} + \ldots + \alpha_n * dl(GDP)_{t-n} + \theta_1 * log(LIBOR3M)_t + \varepsilon_t$

so that not only the time impact of the macroeconomic fundamentals on M&A transactions is measured but also the inverse relationship, as it would be expected a bi-directional effect to occur.

Similarly, Model 2 will follow the same structure as Model 1, with the exception of the dependent variable, that is now the aggregated value of M&A transactions:

(5) $dl(VolumTrans)_t = \beta_0 + \beta_1 * dl\ (VolumTrans)_{t-1} + \ldots + \beta_n * dl\ (VolumTrans)_{t-n} + \alpha_1 * dl(GDP)_{t-1} + \ldots + \alpha_n * dl(GDP)_{t-n} + \Omega_1 * dl\ (FTSE)_{t-1} + \ldots + \Omega_n * dlog(FTSE)_{t-n} + \theta_1 * log(LIBOR3M)_t + \varepsilon_t$

Again, the optimal lag-length is defined using the criterion selected for the VEC. However, even though these estimates provide a useful input for the decision of the number of lags to be used, in a VAR they should not be treated as definitive. According to Stock & Watson (2010), one should make sure there is no autocorrelation in the residuals and that these follow a white-noise process. Therefore, after estimating a VAR with the lag-length with the minimum statistic provided by the information criterion, it is crucial to check for autocorrelation in the residuals: i) through observation of the correlogram; and ii) by performing an LM test. In the first option, the model is valid if no bar crosses the confidence intervals. Alternatively, under the Lagrange Multiplier (LM) test, the correlation of the residuals for the model of the order defined earlier is tested, in which the null hypothesis is the non-existence of autocorrelation until the defined lag. If one of the lags rejects this hypothesis, then the errors do not follow a white-noise process

and thus a new model should be estimated. For instance, if the information criterion suggests a VAR(3), but the lag 2 presents a p-value lower than 0.05 for the LM test (leading to the rejection of the null hypothesis of no autocorrelation), then one should estimate a VAR(4) and perform the test again, until no autocorrelation is found on the residuals. Even though increasing the number of lags could potentially solve this problem, the number of lags should not be too big, as it would lead to the existence of too many parameters in the VAR and consequently a decrease in the likelihood ratio (Lütketpohl, 2007). Afterwards, one can analyze the impulse-responses functions generated by the estimated VAR model.

Empirical Results

Most of the variables (and proxies) employed in this study are documented to be non-stationary in the literature (Chowdhury, 1993). Table III presents the results of the Augmented Dickey-Fuller (ADF) tests (Dickey and Fuller, 1981) on each of the variables of the model. It is confirmed that every single variable used in this model has a unit root. Specifically, NumTrans, VolumeTrans, GDP, FTSE100 and LIBOR3M are found to be non-stationary. Accordingly, the log-series are used in the VEC, whereas log-differenced data is used in the estimation of the VAR, which in turn rejects the null-hypothesis of non-stationarity, confirming integration of order 1 – I(1). (Table III)

Granger Causality Tests

As a preliminary step, I start by testing the bidirectional relationship between variables through a Granger causality test. And the results observed in Table IV seem to corroborate the previous literature. In fact, when setting NumTrans as the dependent variable, both FTSE100 and GDP prove statistically significant Granger-causing the frequency of M&A deals (Table IV).

As for the relationship between the volume of transactions and macroeconomic proxies, the outcome is slightly different (Table V). In fact, GDP still proves significant explaining M&A trends. However, FTSE does not seem as instrumental as the economic output in this case. This is not uncanny: recent research (Choi & Jeon, 2011) has found the stock-market to be the main force driving the frequency of deals but having a considerably smaller effect in overall value of mergers.

Moreover, it is still worth mentioning the results showing that the number of transactions Granger-cause GDP, indicating that this relationship is indeed bivariate. Additionally, the impact of GDP in the stock-market is also significant, which should not come up as a surprise. The results of the Granger Causality Test are an important proxy for the subsequent tests, even with its known limitations, by enhancing the relationships one could expect to be stronger.

Short and long-run dynamics

As previously mentioned, two different models (although similar in its form) are computed, one with NumberTrans as the dependent variable, the other with VolumeTrans. The VEC systems include all described variables, ordered according to preliminary analysis – namely the correlation diagram and Granger tests.

Model 1

VEC model 1 establishes the cross-relationships between Frequency of M&A deals, through the variable d(LnNumTrans), and the set of macroeconomic variables comprising GDP, FTSE100 and the 3-mont LIBOR - represented, respectively, by LnGDP, LnFTSE100 and LnLIBOR3M. A VEC Model measures the short-term corrections of a system of variables towards their long-term equilibrium; however, before that, it is needed to assess whether there is a long-term relationship at all. If two or more variables are cointegrated, it means they share a pattern over time. Computing the Johansen Cointegration Test (Table VI), I reject the null of no cointegration in both the Trace test and the Maximum Eigenvalue Test. Both tests indicate one cointegration equation at 5% significance. There is now ground for estimating the coefficients of impact through a VEC Model.

The different information criteria provide distinct assertions on the optimal lag-length to be applied in the model (Table VII). The common process defined in the literature is to use the VAR to define the lag-length that will after be used in the VEC. The AIC establishes a VAR(2) as the model who could fit the data better, whereas both the SC and the HQ suggest a VAR(1). Therefore, I start by computing a VAR(1), as it implies less lags in the data. However, when computing the LM test the model fails to reject the null-hypothesis of no serial-correlation in the residuals, which would very likely lead to a biased estimation. Accordingly, a VAR(2) is estimated instead. This time, no autocorrelation is detected (Table VIII), which means the residuals follow a white-noise process (Figure I).

The cointegration equation in the Model 1's VEC output (Table IX) gives the estimated long-run relationship among the variables; the coefficient on that term in the VECM shows how deviations from that long-run relationship affect the changes in the variable in the next period. As presented in Table IX, two of the equations ("LnNumTrans" and "LnGDP") show negative and significant coefficients, although the latter only at the 10% level. This means that for these system equations there is a short-run adjustment mechanism to the equilibrium relationship when shocks to the system are sustained.

Based on R-squared and AIC criteria, the equation for the impact of macro determinants on number of transactions is the best specification. This indeed proves the specification that changes in economic conditions impact M&A activity in the long-run. Furthermore, turning to the short-term analysis of this equation, the error-correction terms proves both negative and significant, meaning that a 1% deviation from the long-run equilibrium would be corrected by 0,2% in the next quarter. Additionally, the short-run coefficients for GDP are positive and significant when lagged once and twice, proving that there is a short-term effect of GDP on the frequency of M&A deals. So too is the FTSE significant, seeming the main force driving M&A in the short-term. This outcome is consistent with previous work from Choi & Jeon (2011), who found the stock-market to be instrumental when deal frequency is used as measure of M&A activity.

Additionally, LIBOR3M, included as exogenous, confirms the preliminary results appearing significant explaining merger frequency (with a negative impact, as expected). The impact of interest rates in M&A is not clear in the literature, as different researchers have come up with different results. In the US, where most of the research has been conducted, several relevant studies found it not to be of major importance in aggregated merger activity (using the Fed-funds rate as proxy). However, the American system favors financing through capital markets, thus diminishing the relative relevance of interest rates in companies financing structure (even if it is still a major and vital source of funds for the corporate world). In Europe, bank financing is still the primary financing vehicle for most companies, its relative impact would in principle be higher than the stock market. This might be the case for the UK, although its stock-market is by far the largest in Europe and historically a dominant player in corporate financing, playing a role in the corporate world that finds no parallel in countries like Portugal, Spain or even Germany.

For the equation holding GDP as the "dependent variable", significant at the 10% level, it is shown that shocks impacting the long-run equilibrium in 1% are corrected by 0,02% in the subsequent quarter. L_NumTrans lagged once and L_FTSE lagged twice have a positive impact on GDP - therefore, the hypothesis of M&A activity impacting other macroeconomic indicators cannot be left out.

Impulse responses

Following the outcome of the VEC model, it is worth studying the possible short-run disturbances caused by the explanatory variables. In principle, if there is a long-run impact, a

short-run adjustment mechanism will be spotted, helping predict long-term dynamics. In order to do so, VAR model 1 (Table X) is constructed, using the same variables as before.

Figure II represents the impulse response functions generated by VAR model 1. It shows the patterns of the impulse from, and the response to, specific shocks coming from each of the variables in the model. The output provides a complementary source of information to the simple coefficients of the VAR system.

A shock in GDP impacts the number of deals strongly from the 2th period onwards, which is consistent with previous results. Also similar is the opposite impact, i.e., of shocks on M&A activity on GDP, even if at a smaller scale. Perhaps most surprising is the effect of a shock in the FTSE100 on M&A activity, and vice-versa. The most relevant feature is the fact that the intensity of the shock tends to increase over time, showing greater persistency than GDP itself, which is consistent with the results from the Granger tests, the VEC model and previous literature.

Model 2

As explained before, Model 2 follows the same structure as Model 1. The only major difference is the dependent variable, which this time is LnVolumeTrans, representing the volume generated by M&A transactions during the period. All the other variables, LnGDP, LnFTSE100 and LnLIBOR3M, remain the same. The Johansen Cointegration test (Table XI) shows similar results for the long-term relationship between variables when replacing deal frequency with deal volume. Both the Trace test and the Maximum Eigenvalue test reveal one cointegration equation significant at the 5% level, by rejecting the null-hypothesis of no cointegration. Moreover, this turn, all but one information criteria suggest a VAR(2), and therefore a VEC(2), as the model who could better fit the data (Table XII, Lag-length). Therefore, a VEC with two lags is estimated and, indeed, no autocorrelation is detected in the residuals, as the results of the LM Test, summarized in Table XIII, prove. From the observation of the residuals' behavior, outlined in Figure III, one can draw the same conclusion.

The results of the VEC 2, presented in Table XIV, are not substantially different from those of the previous regression. Again, two equations are both negative and significant, this time the one with Ln_VolumeTrans and Ln_GDP as "dependent variables", the first being more relevant. Regarding this equation, one can conclude that there is a long-run equilibrium, and indeed macroeconomic determinants such as GDP and the FTSE impact the amount invested in M&A in the long-run. The cointegration equation shows all variables to be significant.

So too is the error-correction term. The negative and highly coefficient means shocks causing deviations of 1% from the long-run equilibrium are corrected by half in the subsequent quarter. Furthermore, the short-term estimates indicate that lag one of Ln_GDP and LIBOR3M are significant explaining the amount invested in M&A. This time, however, FTSE is not significant in the short-term. Two possible explanations arise for FTSE's short-term lack of significance. First, the already mentioned lesser weight of funding through capital markets in corporations' financing structure, when compared to the American system. The second is linked to the Expectations Theory. In fact, this theory states that current stock prices incorporate investors' predictions of future economic activity. Therefore, a bull market today does not necessarily mean a current thriving economy, but it does in principle mean that demand will increase in the future. This could be supported by the fact that FTSE is significant in the long-run, implying that an increase in the stock-market performance today can help predict higher M&A activity in the long-term.

Regarding the equation using GDP as dependent variable, it appears to be marginally significant, but a 1% deviation from the long-run equilibrium is only corrected by a 0,02% opposite movement in the quarter after. The short-term adjustments are also not completely statistically supported, even if taking in account the impact of the second lag of FTSE and LIBOR3M.

Impulse responses

VAR model 2 (Table XV) is built in order to generate the impulse-responses matrix. Again, the output shows (Figure IV) GDP's impact on deal volume is null in the first period, but it increases considerably in the period 2 until lag 4, then decreasing slowly up until the 10^{th} lag. Although following a similar pattern, one can conclude that shocks in the GDP will have a more persistent impact in the short-term in deal volume that they have in deal frequency, from the simple observation of its impulse-responses functions. Again, the impact on M&A activity following a shock in the FTSE is not only significant but also highly persistent, and so is the inverse, although at a smaller scale. All other interactions are not considerably relevant.

Conclusions

This research studied the short and long run impacts of a set of macroeconomic variables – GDP, FTSE100 and 3-month LIBOR – on aggregated UK M&A activity, covering a period of 30 years from 1985 until 2015. Similarly to some previous work (Choi & Jeon, 2011; Haque et al., 1995) using two ways of measuring M&A (number of deals and volume generated) meant achieving similar outcomes (the exception being the short-term relevance of the FTSE), so that

we can conclude that both the number and the amount spent in M&A react to the macroeconomic environment in a similar manner. Two theories have been debated in this study, and three hypothesis launched. Hereinafter, all of them will be discussed.

The Expectations Theory debated in the revised literature finds support in the results provided by both models. This theory claims the stock-market performance is a predictor of future economic activity and interest rates decrease companies' financing costs thus stimulating investing through M&A. Benzing, (1991), Shleifer & Vishny, (2003) and Kamali (2007) all found interest rates to have a large impact than the stock-market in the short-term, which finds parallel in the outcome of Model 2. The answer for the lack of significance of the FTSE100 explaining M&A activity, at least in the short-run, could be in the lesser weight of financing through capital markets in the European framework, in comparison with the US system, even if the stock market in the UK is more prominent than in any other European country. But it could also mean that the FTSE is a long-term predictor of future M&A activity, as stock prices today incorporate investors' expectations of future economic activity (Fama, 1981), and indeed the results of both models prove that the stock-market performance drives, at least partially, M&A activity on a long-run horizon.

Moreover, the analysis of the short-run impulse response functions shows that shocks in the GDP have long-lasting effects on M&A. This is highly supportive of the other theory revised in this study, the Economic Disturbance Theory, according to which shocks in macroeconomic fundamentals such as GDP or GNP cause M&A to oscillate. This immediate impact continues in the long-term, as the results of the VEC Model prove. So this theory is not only proved, but it is further confirmed as the effects seem to persist over time. The results obtained are similar to those found by Gort (1969), Dong et al. (2006) and Resende (2008). The latter and Choi & Jeon (2011) claimed, additionally, that these macroeconomic shocks could include variations in the stock-market, itself a macroeconomic fundamental. The VEC models finds the FTSE100 to be cointegrated with M&A activity in the long-run, even if there is not a short-run impact. This result is highly relevant and consistent with that of Choi & Jeon (2011), whose work with VEC models applied to M&A research is well-regarded.

Three hypothesis were hurled in the beginning of this research. The first hypothesis states that an upward economic cycle impacts M&A activity in the short-term. Both models find similar conclusions on this regard. Using GDP growth as proxy for economic growth means confirming this hypothesis, as shocks in this macroeconomic fundamental seem to impact M&A activity in

the following quarters. The VEC Models' results allow hypothesis number 2 to also be validated. In fact, whether impacting on the number or volume, all three macroeconomic variables employed show long-term cointegration with deal activity, so one can assert, for the sample used, that proxies for economic cycles share a pattern with M&A activity.

Regarding Hypothesis 3, it is hard to draw conclusions based on the results obtained. It is true that some sort of causality was established in Model 1, namely the frequency of deals impacting GDP in the short-run. The impulse response functions reveal a slight effect of M&A shocks in economic output, but that is as far as it goes. The long-term analysis for the number of deals is not conclusive, neither for GDP or the stock-market. Similarly, Model 2, both through the VAR or VEC systems fails to provide a definitive proof of the bivariate relationship between economic cycles and M&A activity.

Concluding, this study served the purpose it initially meant to. The empirical research by Resende (2008), that launched the basis for the study of M&A behavior in the UK, suggested that deal activity in the country could be strongly driven by economic factors. Some, like real output and the stock-market performance are included here. Increasing the scope and the complexity of research in the future could narrow the gap between the current understanding of M&A patterns in the US and Europe.

Limitations and future research

Limitations

As with any empirical investigation on M&A, this research faced very specific limitations that, if overcome, could provide better insights on the phenomena. First and foremost, available data for completed deals is limited. As mentioned before, it is not mandatory to disclose the transaction amount (except in some specific cases), so that the quality of the data will always be influenced by the transactions that are left aside the model (at least, for the ones where the volume of deals is considered).

Additionally, there are the limitations the choice of a VAR or VEC Model entails. These sort of models are vectors of matrixes, so that a model with 3 variables will include 3x3=9 interactions. If more variables are added to the regression, then the number of interactions will increase exponentially. Since the data available is aggregated into quarters, adding more and more variables could, in the limit, mean the model would end up with more interactions than observations, which would obviously result in an unviable model from which no adequate conclusions could be drawn. Therefore, the set of explanatory variables had to be narrowed

down to those that could provide better understanding of the phenomena, based on preliminary analysis and literature review. A more complete model, I believe, could provide even better results and complementary insights to those obtained here.

Future Research

This research employs variables as proxies for economic cycles that are standard within the relevant literature. The GDP, the stock-market and interest rates are efficient benchmarks for a country's economic status and have long been preferred by authors to study M&A behavior, particularly in the US. Although these macroeconomic fundamentals, as the empirical results of this study show, prove to be instrumental explaining M&A activity, it is plausible that in European countries, including the UK, factors other than these can also play a major part in the process. Such as mentioned by Resende (2008) and Choi & Jeon (2011), economic factor like the unemployment rate, money supply and industrial production may contribute to a broader and more complete explanation of the M&A wave-type behavior. A model that would combine both these variables and the macroeconomic indicators already included in this research would definitely help better understand the behavioral patterns of the relationship between M&A and economic cycles.

Moreover, this research used two ways of measuring M&A activity that are standard within the literature. Additional measures, such as Transaction value/Stock-market Value or Merger Transaction Value/Total Assets (Choi & Jeon, 2011) could provide a normalization effect and an important contribution to overcome issues resulting from the quality of the data available.

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